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A novel flexible microfluidic platform: Integration of conventional printed circuit board technology and inkjet printing

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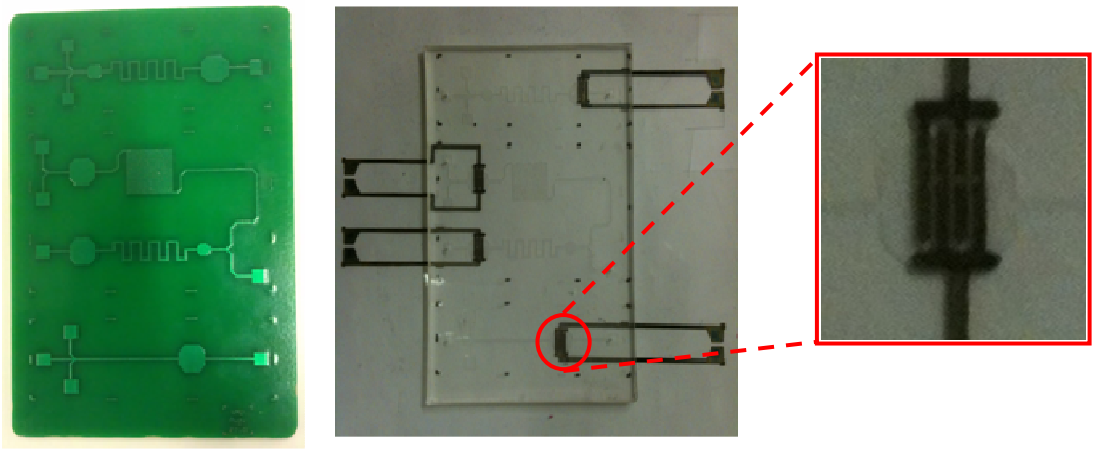
Over the last decade, a steady and considerable effort has been directed towards the development of cost effective microfluidic devices for applications in the biomedical and environmental industries. Typically, master molds for microfluidic channels have been fabricated using silicon based technology which is significantly expensive and time consuming. In recent years, the field of printed electronics, which employs printing methods such as gravure, screen and inkjet printing, has also been gaining remarkable interest due to its ability to batch produce flexible electronic devices.

We report on the successful development of a novel microfluidic sensing platform (MSP) to be used for the detection of various biochemicals. Silver (Ag) based ink, to be used as interdigitated electrodes (IDE), was printed using a Dimatix 2831 inkjet printer on flexible polyethylene terephthalate (PET) substrate. Polydimethylsiloxane (PDMS) based microfluidic channels were fabricated using master molds created with PCB technology. The printed PET substrate and PDMS were bonded using a laboratory corona treater (BD-20AC, Electro-Technic Products Inc.). A photograph of the PCB master mold and the PDMS based flexible MSP, with inkjet printed IDEs, is shown in Fig. 1.

A programmable syringe pump (KD Scientific-KDS210) was used for injecting samples into the microfluidic channels. A custom built LabVIEW program was used for controlling an Agilent E4980A LCR meter to acquire impedance measurements. The dynamic impedance response of the MSP, as shown in Fig. 2, demonstrated percentage changes of 107 % and 28 % for the 1 nM and 1 pM concentrations of KCl, respectively when compared to deionized (DI) water at 1 mV applied potential. The results obtained demonstrated detection levels as low as picomolar concentrations. The details of the MSP as well as its response towards different biochemical compounds such as sarcosine, D-proline and mouse monoclonal IgG including their detection levels will be presented.



(a) **(b)**

Fig. 1. (a) PCB master mold and (b) PDMS based flexible microfluidic sensing platform. (*Inset*) Inkjet printed interdigitated electrodes.

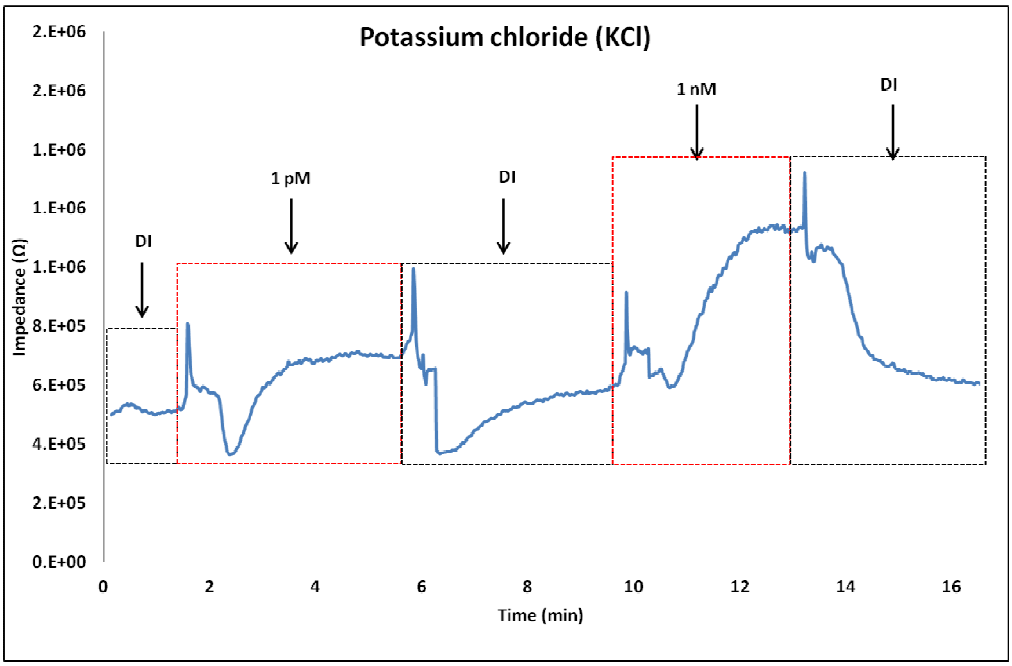


Fig. 2. Electrochemical response of the flexible microfluidic sensing platform to KCl, at a frequency of 1 kHz with a 1 mV voltage excitation.

Keywords: Flexible, Inkjet Printing, Microfluidics, Printed Circuit Board